

ESTABLISHING
PROPERTY RIGHTS IN ENERGY:
Efficient vs. Inefficient Processes

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In order for a society to use its resources efficiently, property rights must be well defined, enforced, and transferable. By now, this basic conclusion of the modern property rights literature needs little defense. Examples abound of the resource waste that occurs when actors do not bear the costs or reap the benefits of their actions. The environmental concerns of the 1960s and 1970s provide excellent illustrations of the usefulness of the property rights paradigm. This paradigm has emphasized the inefficiency that ensues when property rights are held in common. For this reason it provides valuable insights into the allocation of energy resources. Oil is often pumped from pools of very unclear title. Mineral rights and coal rights are often intermixed with rights to surface land. Geothermal resources also have common-pool characteristics. The list goes on and on, but the conclusion remains the same: Inefficiency results from poorly specified rights.

This paper will argue that the economists' maxim of "establish private property rights," which follows from this conclusion, can lead to policy actions that are every bit as wasteful as the inefficiencies mentioned above. We are all well aware of the fact that transaction costs play a role in the property rights structure. "Coase has shown that if exchange costs are positive it is necessary to ask whether government can take the harmful effects of an action into account at less cost than can the market or, indeed, if the resulting resource realignment is worth the costs of taking the side effects

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into account at all.¹ In addition to the exchange costs in the realignment question, we can add the cost of defining and enforcing property rights. Costs of these kinds must be subtracted from the efficiency gain to arrive at an estimate of the net gain from establishing property rights. This conclusion is not new to economists. In what follows, however, we will add a new dimension to the conclusion by pointing out the kinds of costs that may arise in the definition process and by suggesting institutional arrangements under which these costs might be minimized.

Costs in the Definition of Rights

The optimal level of property rights definition and enforcement activity is a function of parameters that continually change.² In the face of changes in income, relative prices, technology, and preferences, the correct specification of property rights will shift. For instance, it would have been socially wasteful in 1830 to have devoted any significant amount of resources to defining and enforcing rights to "wilderness." In fact, the wilderness experience, so much desired today, was then considered a bad rather than a good; it was something to be endured in the pursuit of other, more important ends. However, with less wilderness available, with significant changes in the nature of the workplace and its geographical location, and with rising incomes, wilderness has become a valuable good to some individuals in society. Moreover, to other individuals the wilderness areas have other uses that are incompatible with wilderness. These competing uses raise numerous questions about ownership and use rights. In an effort to capture the value of these rights, individuals and groups devote more resources to the definition and enforcement process.

Oil provides a similar example. Before Colonel Drake's successful oil strike on August 29, 1859, at Titusville, Pennsylvania, crude oil was mostly something that interfered with agricultural production. Little effort was put into defining and enforcing rights to the sticky black ooze. With the development of successful refining processes and the rising price of whale oil, however, the value of crude rose significantly. The result was increased definition and enforcement activity. While the rights issues have been solved in some areas,

¹Harold Demsetz, "The Exchange and Enforcement of Property Rights," *Journal of Law and Economics* 11 (October 1964): 12.

²For a discussion of the optimal level of property rights, see Terry L. Anderson and P. J. Hill, "The Evolution of Property Rights: A Study of the American West," *Journal of Law and Economics* 18 (April 1975): 163-79.

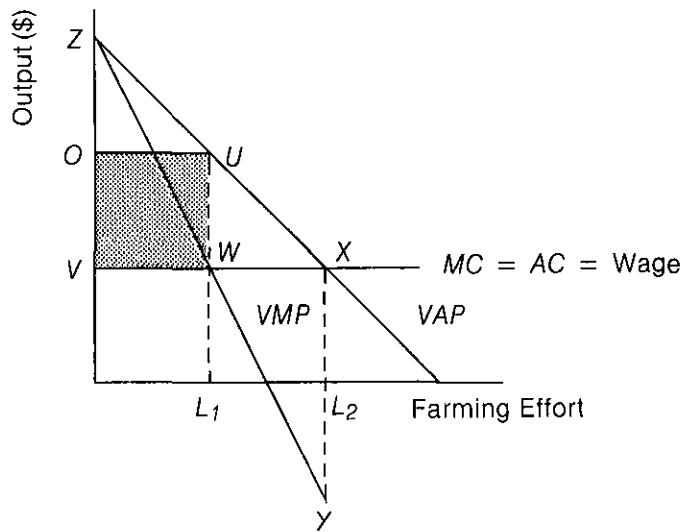
they remain problems in others. As the price has risen and the exploration has expanded to remote ocean and wilderness areas, new property rights issues have arisen.

The important lesson from these two examples is that the optimal level of property rights is continually changing in a dynamic society. Since we cannot know what technology, tastes, and therefore relative scarcity will be for all times in the future, it is impossible to specify property rights completely. Property rights will be produced according to changing variables in the economy. For this reason it is useful for us to pay attention to the different mechanisms or social institutions under which such property rights production will occur. The question is to what extent the institutions are conducive to low-cost changes in the property rights structure. Alternatively stated, do the institutions promote efficient expenditures of resources in the definition and enforcement process? The remainder of this paper will be devoted to a theoretical analysis of these questions and an application of that analysis to property rights in energy.

The *process* by which property rights are defined and enforced is important to an overall examination of efficiency. Privatization of rights provides society with significant gains by eliminating the "tragedy of the commons." The best exposition of the social waste inherent in common property or, conversely, the gains from privatization is found in Cheung's "The Structure of a Contract and the Theory of a Non-Exclusive Resource."³ If an individual starts to use an unclaimed resource, he will apply L_1 units of labor to that resource, as illustrated in figure 1. In other words he will use labor until its $VMP = MC$. A residual, or a rent, of $OUWV$ will be generated. However, because of a lack of exclusion, other individuals will attempt to capture a portion of the rent, and as more and more entry occurs, in the limit L_2 units of labor are applied. Equilibrium occurs at L_2 because at this level of activity all of the rent to the fixed resource is exhausted. However, there is social waste of WXY because the value of the marginal product of the variable input is below its marginal cost over the range L_1, L_2 . Since this waste is equivalent to the rents that would exist if entry were limited to one individual, $OUWV$, the gains to privatization are obvious. If private rights are costlessly defined and enforced, society will gain the rents $OUWV$; if the rights are left in the commons, rents will be dissipated, and the waste will be $OUWV = WXY$.

³Steven N. S. Cheung, "The Structure of a Contract and the Theory of a Non-Exclusive Resource," *Journal of Law and Economics* 18 (April 1970): 49-70.

FIGURE 1
RENT DISSIPATION IN THE COMMON POOL



The process of defining and enforcing those rights, however, is not costless. What determines the amount of resources that will be devoted to privatization? In the limit, potential claimants can afford to devote resources equal to the entire amount of the gain from private rights, or in this case, $OUWV$. But this is precisely the loss due to not having private rights! The effort to avoid the tragedy of the commons has created another tragedy, equally costly to society, namely the tragedy of private rights creation.

Of course, the interesting question becomes, How likely is it that total rent dissipation will occur in the process of defining and enforcing rights? To answer that query we turn to the standard neo-classical paradigm and reply: It depends on the incentives to those who are designing and implementing the property rights apparatus. Since there are gains to selecting low-cost methods of establishing property rights, the crucial issue is who, if anyone, can capture those gains. We postulate that if those who stand to gain from the privatization, that is, those who are potential claimants of the rents, are intimately involved in the definition process, the results will be significantly different than if those designing the process have no claim on the gains from such privatization. In the case where claimants are involved, they will have strong incentives to design low-cost definition methods; any resources saved in the definition and enforcement process increase their share in the rents created by

such definition. However, if the choice of method is in the hands of those who have no residual claim on such rents, there is little or no incentive to choose low-cost institutional arrangements. In fact, perverse incentives may exist, encouraging methods that actually maximize rent dissipation.

Consider the case where the means of defining and enforcing rights is in the hands of a utility-maximizing bureaucrat. Such an individual is in the position of rationing the rent that will exist once property rights are defined and enforced. We repeat that potential owners will be willing to spend up to the expected value of the gains from privatization to obtain the rights. Auctioning off the well-defined and enforced rights under competitive conditions would force potential owners to pay the entire value of the rent. Such an expenditure would not constitute resource waste or inefficiency, since it would only involve the transfer of ownership claims from the potential owner to the government.

In most situations, however, the revenues from this auction would not go directly to the decision-making bureaucrats. Rather, they would go into the common revenue pool of the government. Since the utility-maximizing bureaucrat will only get a small share of that common pool, he will not have an incentive to choose this rationing mechanism. If the revenues went directly to the particular bureau making the decision, the incentive for efficiency would be improved. Again, however, the common-revenue-pool problem exists within most bureaus.⁴ Utility-maximizing bureaucrats will therefore have an incentive to avoid efficient auctions and choose mechanisms that produce more direct benefits to themselves. Bribes offer one means of doing this, but, while they are as efficient as auctions, they are generally illegal.

This forces utility-maximizing bureaucrats to opt for actions on the part of potential claimants that will generate utility for the bureaucrat. The person in control of rationing the rights can require elaborate demonstrations of "need," or social worthiness, on the part of the claimant. For example, in the case of broadcast frequencies, bureaucrats stipulate the portion of the broadcasters' time to be devoted to "public interest" programming. They can require that use rates of resources agree with their own view of the correct rate. They can force the resource claimant to perform other activities that yield them satisfaction. All of these activities will be

⁴For a discussion of the treasury as a commons, see John Baden and Rodney D. Fort, "Natural Resources and Bureaucratic Predators," *Policy Review* 11 (Winter 1980): 69-81.

consented to by those desiring the property so long as the cost does not exceed the rent generated. In the limit these activities can exhaust the entire societal gain from establishing private rights. To the extent that the activities use resources with opportunity costs and produce something that would not be produced without these requirements, inefficiency or waste is the result.

Property Rights on the Western Frontier

Before turning to the implications of the above theory for energy resources, it is useful to illustrate the different processes of defining and enforcing rights with examples from the American West. For most of the American frontier, settlement preceded the establishment of a formal institutional order. As a result, it was possible and indeed necessary for local groups of potential property-rights claimants to settle upon definition and enforcement methods.⁵ If the analysis presented above is correct, we would expect these groups to choose cost-minimizing processes for establishing property rights. A few brief examples suggest this was the case.

Because riparian water doctrine was decidedly inappropriate for the arid West, alternative water-rights schemes evolved. The riparian doctrine held that stream bank landowners all had equal rights to the flowing resource but that they could not divert it. With abundant waterfall east of the 100th meridian, diversion was not necessary. In the West, however, the scarcity of water made diversion imperative. Miners were the first to see the clear gains from a different definition and enforcement procedure. The doctrine they chose of prior appropriation reflected their desire to conserve the resources used in the definition and enforcement process. This doctrine granted exclusive rights to the first appropriator on a stream; to later appropriators went rights conditioned upon the prior rights. The doctrine also permitted diversion and allowed for transfer and exchange. Transaction costs were reduced, and a relatively efficient water doctrine was agreed upon by those who had claims on the gains from privatization.

Likewise, rights to land often were established in a quasi-legal fashion by individuals who had claims on the gains from the establishment of private rights. Claims clubs arose in areas where settlement was occurring prior to formal opening of the land and thus prior to access to federal government definition and enforcement

⁵For a more complete discussion, see Terry L. Anderson and P. J. Hill, "An American Experiment in Anarcho-Capitalism: The *Not So Wild, Wild West*," *Journal of Libertarian Studies* 3, no. 1 (1979): 9-30.

processes. Each club or association was governed by a constitution agreed upon by the members. Under these rules each settler's claim was registered, protection was provided, and disputes were adjudicated. The rules that stipulated what was necessary to formally establish rights did not require that effort be wasted in the process. In general the association did not use acreage limitations, did not require unnecessary improvements, and, in some cases, did not even require residence. As residual claimants, the members of the claims clubs had an incentive to minimize definition and enforcement costs.

Contrasted with the rules of claims associations were the Homestead Acts. Under these laws, rules for establishing property rights to land were drawn up by individuals who had no direct claim on the gains created by the move from common property. Thus there were no incentives to choose methods that minimized resource use in the definition process. The Homestead Act of 1862 required five years of residence for a claim of 160 acres. Preemption after six months of residence was allowed upon payment of \$1.25 per acre. The original act was revised and expanded numerous times over the next several decades, but in no case was low-cost definition of rights allowed. Resource waste occurred in two major ways. Since the law usually restricted holdings to a size below that which was economically efficient, too many people lived on the land. Second, other unnecessary resources were required to be invested. Trees were planted where they otherwise wouldn't have been, irrigation systems were set up that were not economically viable, and, in much of the West, land was plowed that was better suited to grazing. Thus the homestead system, designed and implemented by people who had no direct claim on the gains from privatization, differed markedly from that of the claims clubs.⁶

Modern Examples of Waste in Energy Resource Privatization

With these examples in mind we now turn to energy and suggest that under the existing institutional structure something similar to the waste of the Homestead Acts has occurred and will continue to occur. As many energy resources become increasingly valuable, alterations in the rights structures will have to occur. However, it

⁶For a discussion of the federal system of timber disposal, see Gary D. Libecap and Ronald N. Johnson, "Property Rights, Nineteenth-Century Federal Timber Policy, and the Conservation Movement," *Journal of Economic History* 39 (March 1979): 129-42.

may well be that the processes chosen for establishing new rights will exhaust all of the gains from the creation of private claims.

A. *Offshore Oil*

Our first example of a wasteful definition process comes from the United Kingdom. The discovery of oil and gas in the North Sea in the 1960s represented one of the more significant discoveries of the last several decades. The proximity of these reserves to major energy markets combined with the development of the technology necessary to exploit the reserves suddenly made a common-property resource valuable. Countries bordering the North Sea immediately attempted to (1) more precisely define their rights to the sea and (2) settle on a method of allocating rights for exploration and production in the areas over which they had jurisdiction. Each country seemed very much aware of the problem of common property and understood that allowing unlimited access would be socially wasteful. In other words, they understood that rents from the resource could be increased through access restrictions. However, in the case of the United Kingdom, since those establishing the process had no claim on the rents from establishing private rights, the chosen system of privatization may have been as wasteful as common property.

At the time of the North Sea discovery, the Conservative party was in power in England. Had the Labor party been in power, it is likely that all exploration and production would have been carried out by the government itself. The Conservatives, however, advocated private development. To accomplish this they established a system of private rights to explore and produce, and thus they eliminated the inefficiencies of common-pool ownership. But at the same time their processes for establishing rights encouraged wasteful resource investments.

The basic mode of granting rights came in the form of licenses to explore and produce from predetermined blocks, usually rectangular in shape. The blocks were eight to nine miles (east-west) by eleven miles (north-south).⁷ The licenses were granted to competing oil companies and were for areas one to ten blocks in size.

With the rights defined in this way, the next question was to whom they should be assigned. Given the competition for the scarce resources, one efficient technique of establishing ownership claims would have been an auction. This would have allowed the

⁷Kenneth W. Dam, "Oil and Gas Licensing and the North Sea," *Journal of Law and Economics* 13 (October 1965): note 15, p. 55.

resources to go to the highest-valued user without dissipating the gains from privatization in resource-using activities. In this process bidders may well bid up to the value of that gain, but, in sharp contrast to other methods, that value is simply transferred to a different owner rather than consumed. The British Ministry of Power, however, rejected a formal auction. Instead it chose a method of bidding for leases in which the bids were in the form of proposals of how much exploration was planned by the developer.

More significant, however, was the Ministry's request for a statement of each company's work programme for the blocks for which it was still in the running. It came to be known that the Ministry expected much more active drilling programmes in areas which were widely sought after than in less coveted areas. Indeed, by a process which is none too clear to the outsider looking in after the fact, a "going price" came to be known for each area. This going price was denominated in such things as holes drilled and exploration work undertaken. He who was unwilling to pay the going price could not expect to be awarded a licence. This system could thus be characterized as a competitive bidding system in which the bid was the work programme of the applicant. Moreover, where an applicant's work programme for a particular block seemed insufficient to the Ministry, he was informed that unless he increased the extent of exploration and drilling activity he could not expect to receive a final allocation of that area. By means of this kind of direct negotiation, the Ministry was able to introduce an element of competition into the work programmes.⁸

This form of competition led to an inefficient allocation of resources. Some exploration and production probably would have taken place under any alternative system. The Minister of Power, however, could require exploration at a rate far more rapid than would have existed under efficient market conditions.⁹ Furthermore, he could require that more holes be drilled per block than otherwise would have been drilled. The minister's statement that there was a "need to encourage the most rapid and thorough exploration"¹⁰ of the resource suggests that exploitation may have been too rapid. The British government seemed to feel that market rates of oil and gas exploration would have been inappropriate and that it was desirable to encourage faster use. The oil companies

⁸ *Ibid.*, pp. 59-60.

⁹For a discussion of how these problems influenced federal land policy, see Taylor R. Dennen, "Some Efficiency Effects of Nineteenth-Century Federal Land Policy: A Dynamic Analysis," *Agricultural History* 51 (October 1977): 718-36.

¹⁰Quoted in Dam, "Oil and Gas Licensing," p. 56.

were willing to engage in such activity because of the gain they captured from privatization.

There is also evidence that the ministry took considerable effort to find out just how far the oil companies would go in performing unnecessary activity. In other words, it was deemed desirable to dissipate *all* the gains from privatization. The Minister of Power stated:

In some cases the programme of work first proposed was inadequate, and I had to insist on improvements. As a guide to the size of this great enterprise you may care to know that the minimum work programmes finally agreed to are estimated to cost at least 80 million and that exploration drilling will be carried out under all licences, though the programmes naturally vary from area to area.¹¹

In the United States the Outer Continental Shelf Lands Act of 1953 seems to have avoided the inefficiencies of "work effort bidding" through 1977. Up to 1977, formal options were used exclusively to assign rights to offshore reserves. This process avoided the unnecessary resource waste that has occurred in the United Kingdom. But even in the United States, the common-pool nature of the rents from privatization is beginning to show signs of encouraging wasteful rent-seeking efforts. In 1977 the House and Senate debated amendments to the Outer Continental Shelf Lands Act that are designed to reduce the "unfair advantage" of cash bidding by forcing part of the bid to be in the form of work effort.¹² Such efforts are consistent with the predictions of the analytical framework described above.

In addition to work effort, there are other ways in which the privatization process has promoted social waste. If the size of blocks is too small, there will be overlap between the individual oil and gas reservoirs. As a result the reservoirs will in effect remain common pools. Each lessee will have an incentive to explore and produce at a rate more rapid than optimal in order to capture the resource beneath his tracts.

The Outer Continental Shelf (OCS) area is divided into tracts of 5,760 acres (9 square miles), but even this size is too small to prevent some overlapping of individual reservoirs. . . . The unitization of a common pool in Prudhoe Bay in 1975 involved eight oil companies which had drilled a total of 138 wells. Usually three or four wells are sufficient to explore the potential of an anticlinal

¹¹ *Ibid.*, p. 63.

¹² See Senate Report no. 95-284 (1977), pp. 9-13 and House Report no. 95-590 (1977), pp. 10-15.

structure of relatively simple geology, but where a single structure is overlaid by four adjacent OCS tracts and each is leased to a separate firm, two or three wells per tract are required. Fewer total wells would be required, often by as much as 40 percent if a single firm could test the entire fault structure with a single hole near the junction where the four corners meet.¹³

Clearly the suboptimal size of OCS tracts promotes common-pool inefficiency. Kenneth W. Dam argues that the same kind of inefficiency exists in the United Kingdom.¹⁴

One can ask why the regulators choose such small areas for leasing purposes. From the viewpoint of the bureaucrat issuing the lease, not having a claim on the gains from privatization means that it costs little or nothing to satisfy one's concept of equity. In the North Sea case the Ministry of Power seems to have had preconceived notions about what would be the "fair" allocation of rights. "One is led to surmise that smaller blocks may have enabled the Ministry to make a 'fair' distribution in the most coveted areas."¹⁵ If there were a person or group with a claim to the residual gains from privatization, a trade-off would have to be made between justice and efficiency. In the United Kingdom this trade-off was not recognized. Allowing a definition and enforcement process that did not promote social efficiency caused no decrease in the net wealth of the decision makers.

One final aspect of the U.K. offshore licensing procedure illustrates the rent-seeking activity prompted by the common-pool nature of this privatization. The United Kingdom regulations provided for a six-year lease, at the end of which the licensee could renew for forty years, providing he surrendered one-half the area he held. This area was made available for relicensing. Since licensees can choose which portion to surrender, they have a strong incentive to explore very rapidly in order to determine which portions to retain. Again, in order to maintain rights, the licensee would be willing to expend up to the entire gain from privatization. The potential result is that society will be no better off with "privatization" than it would have been had the North Sea remained common property.

In summary, the evidence on the procedure for the privatization of offshore oil and gas suggests that bureaucrats who have no direct

¹³Ross D. Eckert, *The Enclosure of Ocean Resources* (Stanford, Cal.: Hoover Institution Press, 1979), pp. 103-4.

¹⁴Dam, "Oil and Gas Licensing," pp. 55-56.

¹⁵*Ibid.*, p. 69.

claim on the rents to the resource have an incentive to encourage wasteful resource expenditures by the potential owners. Forcing the competitors for tracts to expend resources in the definition and enforcement process increases the power of utility-maximizing bureaucrats. Ross Eckert captures the essence of the problem: "The ministry in charge of licensing avoids stating in advance the precise work effort that is required to win a license, so firms are led to compete by offering greater rates of exploitation and presumably extraction. This ambiguous basis for awarding leases enhances the ministry's discretionary authority, especially where there is intense competition for a few tracts."¹⁶

B. Onshore Fossil Fuels

Our second example of resource waste generated through the privatization process is that of fossil fuels on or under public lands. The increased demand of the last decade for energy has increased pressure for exploration and production from federally owned land. Coal, oil, natural gas, and oil shale are all resources for which property rights must be defined if exploitation is to occur at a socially desirable rate. To reduce the inefficiency created when resources are held in common, access to federal lands has been limited, thus providing a step toward private ownership. However, since those individuals determining who gets the access have no direct claim on the rents, there is no incentive to use low-cost methods of defining and enforcing rights.

Probably the most wasteful practice used in assigning rights to federal resources is that of requiring continued production.¹⁷ With no such requirements and complete private ownership, owners would choose a rate of extraction that would take into account both present and future values of the energy. The profit-maximizing individual would be able to choose a time distribution that maximizes the economic rent or gain to society from using the energy. If the private owner expects energy to be more valuable to future generations than to the present, a market system based on private rights would allow those future generations to express their preferences. Present owners who believe resources will be more valuable in the future would have an incentive to withhold the energy from present consumption so that it might be available to those in the future

¹⁶Eckert, *Enclosure of Ocean Resources*, p. 107.

¹⁷It should be noted that this will not be a wasteful practice if the government's system of reservation is promoting the optimal level of conservation.

who are willing to pay more for it. Speculation gives future consumers a voice today.¹⁸ Thus, if energy sources will become more valuable over time, as many predict, it would be desirable to have a system that allows private owners of energy to save it until it has the most value to society.

Present federal leasing rules do not do this. Instead, they specify that continued production is necessary in order to maintain the lease.¹⁹ With coal, for instance, leases are for twenty years and so long thereafter as coal is produced in commercial quantities. Competitive leases for oil and gas within a geological structure known to contain reserves are for five years and continue so long as production is continued. Noncompetitive leases where the reserves are not proven are for ten years and likewise are renewable only so long as there is production in commercial quantities. Outer continental shelf leases for oil and gas have similar requirements. Also, to maintain lease rights to oil shale on federal lands, although the procedure is not yet well established, continued production has thus far been required.

The extent to which continued production requirements cause waste will increase as energy supplies increase in future value. Potential leaseholders will be willing to meet the inefficient rates of energy utilization because it is the only way they can claim a part of the economic rent. In the limit, however, the total social value of these rents can be offset by an inefficient time path of use. The bureaucratic decision makers who have no direct claim to the rent have an incentive to encourage this inefficient time path for two reasons. First, the continued production requirement gives these individuals discretionary power. Second, given the shortsightedness effect in government,²⁰ there is an incentive to produce energy for present generations who can vote rather than for future generations who cannot. Continued production requirements offer the bureaucrat an opportunity during an "energy crisis" to show that energy production has increased as a result of his actions. But, as we have demonstrated, establishing rights to energy on the basis of this continued production dissipates the gains from privatization.

¹⁸For a discussion of the role of speculation, see Richard Stroup and John Baden, "Property Rights and Natural Resource Management," *Literature of Liberty* 2 (October/December 1979): 19-24.

¹⁹Stephen L. McDonald, *The Leasing of Federal Lands for Fossil Fuels Production* (Baltimore: The Johns Hopkins University Press, 1979), p. 23.

²⁰For a discussion of the shortsightedness effect, see Stroup and Baden, "Property Rights and Natural Resource Management," p. 16.

C. Solar Collection

In the cases above we have argued that, in attempting to reduce common-pool problems in energy development, government agencies have created processes of defining and enforcing rights that are inefficient. Because those designing the rights mechanisms have no claim on the gains from privatization, they have no incentive to choose efficient methods of defining and enforcing those rights. We now turn to an interesting case where rights are well defined and enforced and where there is little rent dissipation, but where there is pressure to replace the existing process with one that may encourage rent dissipation.

To understand the property rights problems with solar energy, it is first important to understand that it is the collection sites that are scarce rather than the energy source itself. Therefore rights to solar energy are closely tied to property rights in land. The legal maxim governing solar rights is *Cujus est solum ejus est usque ad coelum*. This means that with land comes the right to the airspace above the land. The maxim does not guarantee the landowner the rights to solar collection, however, since a major portion of the sun's energy does not strike property from directly above. In spite of this the system works reasonably well by allowing and encouraging landowners to purchase easements to a portion of an adjacent owner's airspace. These easements can specify the angle of sunlight purchased and are recorded in local land records along with land deeds. Like any property rights, there are some transaction costs inherent in the exchange process, but so long as rights are clearly defined and the market mechanism is allowed to function, resources move to their highest-valued use with a minimum of resource expenditure.

Despite this rather well-functioning property-rights system, there is pressure to replace it with alternative mechanisms for defining rights. One author argues that "the main advantage of relying on private easements to protect solar access is that obtaining them is a time-consuming bother. It is human nature to neglect such bothersome chores until a firm deadline of some sort is encountered."²¹ She further states that "protecting solar access solely through the purchase of private easements is not a satisfactory solution. . . . Because selfish concerns and short-term interests tend to dwarf societal or long-term interests, laws are needed."²² It has been suggested that "the judiciary, the federal government, state govern-

²¹Gail Boyer Hayes, "Out of the Shadows," *Environment* 21 (September 1979): 16.

²²*Ibid.*, p. 17.

ments and their political subdivisions could all handle questions of sunlight allocation."²³

The suggested rights structures almost all contain provisions that represent resource waste. For instance, under many of the proposals, in order to establish solar rights one must be putting the solar energy to "beneficial use."²⁴ Thus, as under the Homestead Acts, resources must be expended to maintain one's rights, even if the present value does not justify such an expenditure. The antipathy to letting people own rights without production requirements is expressed this way: "The loss of solar rights must be provided for if a rights system is to work. A party cannot be allowed to sit on his rights."²⁵

Again, the most interesting thing about all of the controversy over solar collection rights is that the existing system works well. Rights to the gains from privatization are already well defined and enforced. What seems to be happening now is that nonclaimants are dissipating these gains by requiring rights owners to make additional and wasteful efforts simply to maintain their rights. Our point is not only that inefficient processes may be chosen in the move from common to private property, but that additional rent dissipation may actually be encouraged in the continued enforcement of rights.²⁶

D. Geothermal Resources

"The subject at hand involves a resource which is basically a gas. Or a liquid. Or a solid. In any case, it either is, or is not, a mineral."²⁷ This description of geothermal energy provided by mining engineer George Abbott captures the difficulty of defining rights to geothermal energy. Since it is not entirely clear whether a geothermal resource is water or mineral, it is difficult to know which laws apply to property rights in it. As a result there is con-

²³"The Allocation of Sunlight: Solar Rights and the Prior Appropriation Doctrine," *University of Colorado Law Review* 47 (Spring 1976): 422.

²⁴See, for example, Russell J. Adams, "An Analysis of Solar Legislation—Taxes and Easements," *Land and Water Law Review* 14 (1979): 416; and Deborah Grout, "Access to Sunlight: New Mexico's Solar Rights Act," *Natural Resources Journal* 19 (October 1979): 958.

²⁵"The Allocation of Sunlight," p. 441.

²⁶For a complete discussion of this type of rent dissipation, see Terry L. Anderson and Peter J. Hill, *The Birth of a Transfer Society* (Stanford, Cal.: Hoover Institution Press, 1980), chap. 2.

²⁷Quoted in Gerald J. Kitchen, "Geothermal: the Resource, the Law and the Landman," *Rocky Mountain Mineral Law Institute, Proceedings of the 22nd Annual Institute, July 22-24, 1976* (New York: Matthew Bender Co. 1976), p. 821.

siderable controversy over the ownership of geothermal energy.

The first issue to be resolved is whether geothermal resources belong to the federal government or to the states. In cases where the federal government has jurisdiction, the Geothermal Steam Act of 1970 and the Federal Land Policy and Management Act of 1976 govern the allocation of geothermal energy. Under these acts, leases of known geothermal resource areas (KGRA) are to be issued through competitive bidding. As already mentioned, this procedure avoids waste in the privatization process insofar as it does not require continued production in order for the lease to remain valid.

Where geothermal resources fall under state jurisdiction, the laws of the respective states govern their use. There appear to be three general processes for privatization in state laws. The first, in California, establishes rights on the basis of the actual drilling of a well. Once a well is drilled and is producing, a "certificate of primary purpose" may be applied for from the Geothermal Resources Board. The possible inefficiency in this process is in premature exploration and production. The second process for establishing rights to geothermal energy is based on overlying land ownership. Arizona and Oregon laws grant ownership on this basis. In both cases the potential common-pool problem is addressed through regulation of drilling, or some form of unitization. As long as the rights to land are well defined, it appears there is little rent dissipation under this system. The final system exemplified by Montana and Wyoming law uses appropriation to determine ownership.

In Montana the agency is required to issue a permit if (1) unappropriated water is present in the sources of supply; (2) the rights of a prior appropriator will not be adversely affected; (3) the proposed means of diversion or construction are adequate; (4) the proposed use of "water" is beneficial; and (5) the proposed use will not interfere unreasonably with other planned uses or developments for which a permit has been issued or for which "water" has been reserved. If the above criteria are met, a permit is issued; upon application of "water" to a beneficial use and compliance with the permit conditions, a certificate of water rights is issued.²⁸

This system has all of the obvious problems of rent dissipation that have been discussed above.

Inefficiencies in the process of privatizing geothermal energy resources are less obvious than in privatizing other energy reserves. Nonetheless, the rent-seeking model's predictions are borne out in

²⁸Sho Sato and Thomas D. Crocker, "Property Rights to Geothermal Resources," *Ecology Law Quarterly* 6 (1977): 491.

many cases. In a most complete article on the "Property Rights to Geothermal Resources," Sho Sato and Thomas D. Crocker summarize the rent dissipation:

Governmental leasing regulations impose transaction costs in addition to those normally associated with the negotiation between the parties to the exchange. For example, under the federal leasing provisions, assignments must be approved by the Bureau of Land Management. The approval is designed to make certain that the assignee is qualified, that the maximum acreage holding is not exceeded, and that the lease hold is not carved up into small parcels. In addition, the approval of the Supervisor must be obtained in order to change the method of recovering production or to redrill, deepen, or plug back wells. The need to seek these approvals and the possibility of disapproval are costs of undertaking an exchange.²⁹

Summary and Recommendations

We have argued in this paper that the social gains (rents) from establishing private property rights may be nullified by social waste (rent dissipation) in the privatization process. In light of the rapidly changing structure of property rights in energy resources, it is important that we keep this potential for social waste in mind when considering institutions for the definition and enforcement of rights. The evidence presented above suggests that in the cases of offshore and onshore oil, solar energy, and geothermal energy, some of the current privatization institutions are encouraging this type of rent dissipation. We are not able to accurately estimate the amount of this dissipation, but we can be sure that it is serving to offset the efficiency gains that accompany private property rights. *The greater the competition for these rights, the greater the likelihood that full dissipation will occur.*

It is easy to be critical of existing institutions, but much more difficult to propose something better. In the search for an alternative, it is useful to consider what we proposed initially as the cause of rent-dissipating institutions. We argued that if the person or persons choosing the process for defining and enforcing property rights had no stake in the gains from privatization, there would be little or no incentive to conserve the resources used in the process. Even worse, if the person derives utility directly or indirectly from expending resources in the process, there is an incentive to encourage this expenditure.

²⁹ Ibid., p. 511.

Eliminating this waste, therefore, requires either finding institutions that give the decision maker a claim to the residual from privatization, or making the process random so that resource expenditures will not affect the assignment of rights. There are two possibilities for giving the decision maker a claim to the residual. First, we might consider the examples of the American West discussed above, where the individuals interested in obtaining rights established the process for assigning them. Further evidence supporting this approach is provided by the private interests in manganese nodule mining on the open sea. In an article entitled "Market Failure, the Common-Pool Problem, and Ocean Resource Exploitation," Professors Sweeney, Tollison, and Willett make a case for this possibility.³⁰ The voluntary unitization of oil fields also suggests that potential claimants will search for privatization processes that reduce transactions costs.³¹

A second way of giving the person or persons establishing the processes a residual claim would be to allow all of the proceeds from the sale of rights to go directly to the governmental bureau or agency in charge of assigning the rights. We have already seen that some offshore oil rights and some geothermal rights are sold at competitive auction. The fact that the proceeds go into the general fund, however, means that the agencies in charge only have claim to a small percentage of the receipts. Even though an agency might not be a profit maximizer, with a full stake in the residual it would at least have less incentive to encourage wasteful rent-seeking.

Finally, a simple lottery could help reduce the rent-seeking activities. Random selection would mean that there would be no return on investments to influence the distribution of rights. It can be argued that there are other unnecessary transaction costs with this method; once the resources are randomly allocated, a market will form as individual claimants attempt to move them to their highest-valued opportunities.³² A simple auction in the first place could eliminate this step, but with the simple auction we have seen that there is the problem of keeping the receipts out of a common pool. The lottery method does have one advantage over the auction in

³⁰Richard James Sweeney, Robert D. Tollison, and Thomas D. Willett, "Market Failure, the Common-Pool Problem, and Ocean Resource Exploitation," *Journal of Law and Economics* 17 (April 1974): 191.

³¹For a discussion of voluntary unitization, see Leo Hoffman, *The Voluntary Pooling and Unitization of Oil* (Albany, N.Y.: Bender, 1954).

³²For a more complete discussion, see Sato and Crocker, "Property Rights to Geothermal Resources," pp. 508-12.

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that it avoids some of the distributional questions. With random allocation, the rich have no better or worse chance than the poor.

As long as we continue to dissipate the gains from privatization through the definition and enforcement process, we can be sure that we are not getting the most from our energy resources. We must be on the lookout for new institutions that eliminate this inefficiency. The current bureaucratic structure offers little hope.